BetterStart
Child Health and Development Research Group

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Art by Elinor, age 5

Research Series

Can linked data help to better target family support programs for child health and development?

Our research partners in Child and Family Health Services (CaFHS) in South Australia deliver a universal contact visit to families within the first few weeks of the birth of their baby. The universal contact includes eligibility screening for a more intensive service response over the first one to two years of life. The goal is to provide more support to those facing greater barriers to effective parenting. This goal is consistent with best practice by providing a proportionate or progressive universal service response – universal services for everyone with a greater response to those facing greater parenting barriers.

What is not known is how well a range of socioeconomic, demographic, and birth characteristics of families predict later child health and development outcomes. This approach focuses on prevention and improving equity. Providing targeted more intensive support may help prevent poorer outcomes for children in the future, and reduce health and developmental gaps at school entry.

Data linkage for child health and development in South Australia

We used linked data from several population-based administrative sources that are part of the Early Childhood Health and Development Data Linkage Project to help us to understand which early life factors best predict later child health and development. This could be used to help inform eligibility criteria for intensive support programs. This data linkage project allows us to examine the information in birth and perinatal records for all children born in South Australia (SA) between 1999 and 2005 (about 120,000 children). We can link this early life information to later outcomes collected by other agencies such as SA Health, Women's and Children's Health Network, Department for Education and Child

Development, and the Australian Government Department of Education, which includes hospital admissions, child health records, and educational and developmental outcomes up to age 11.

Can we predict poor child development at age 5 from birth and perinatal factors?

We examined the ability of birth and perinatal factors to predict child development at age 5, using Australian Early Development Index (AEDI) data collected as part of the Australian Early Development Census (AEDC) funded by the Australian Government Department of Education. The AEDC was first implemented in 2009 and involves teachers completing the AEDI questionnaire for students in their first

year of school. The AEDI includes 95 questions that assess five domains: physical health and wellbeing; language and cognitive skills; emotional maturity; social competence, and; communication and general knowledge. In this research we classify children who score in the lowest 10% on two or more domains as "developmentally vulnerable". About 1 in 10 children in SA are developmentally vulnerable on two or more AEDI domains. With 20,000 five-year-olds in SA, approximately 2000 are developmentally vulnerable.

Measures of predictive ability: discrimination

We used a standard epidemiological measure – the Area Under the Receiver Operating Characteristic (AUROC) curve – to indicate the ability for various combinations of risk factors to *discriminate* between children who are and are not vulnerable on the AEDI. An AUROC of 0.5 would indicate that the risk factors have no ability to discriminate (i.e., no better than chance alone); an AUROC of 1.0 would indicate perfect discrimination. We present results for males and females separately, because of the well-known developmental differences between boys and girls at this age. If we grouped all children together, then the most important predictor of developmental vulnerability at school entry would be male sex. In a proportionate universal service framework, child sex may be an unhelpful criterion to inform targeting of services.

In the most parsimonious model, we found that six risk factors available in the perinatal data demonstrated moderate discrimination (AUROC = 0.67 for males, 0.72 for females) to predict vulnerability on two or more AEDI domains at age 5. These six risk factors were: area level socioeconomic disadvantage, mother's marital status, mother's and father's occupation status, number of previous pregnancies resulting in births ≥ 20 weeks, and mother's smoking during pregnancy. Addition of other characteristics such as birth weight, maternal age, or Aboriginal or Torres Strait Islander status did not substantially improve discrimination.

Using females as the example, an AUROC of 0.72 means that a randomly selected female who is

developmentally vulnerable would have a 72% probability of having a higher risk score based on their birth characteristics compared to a randomly selected female child who was not vulnerable.

Measures of predictive ability: sensitivity

The *sensitivity* of the risk factors indicates the proportion of children who were classified as vulnerable at age 5 on the AEDI, who could be identified at birth from the six characteristics described above.

Figure 1. *Sensitivity of having at least 1, 2, or 3 of the six risk factors for predicting vulnerability on two or more AEDI domains among boys*
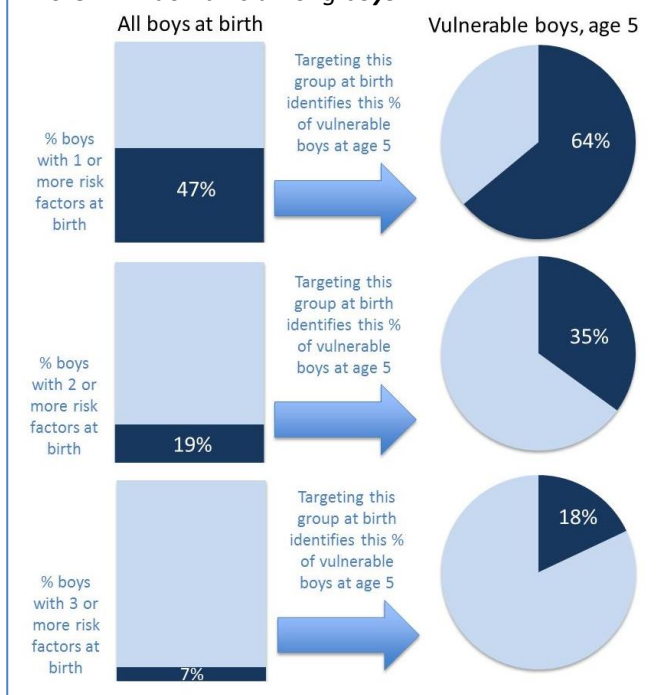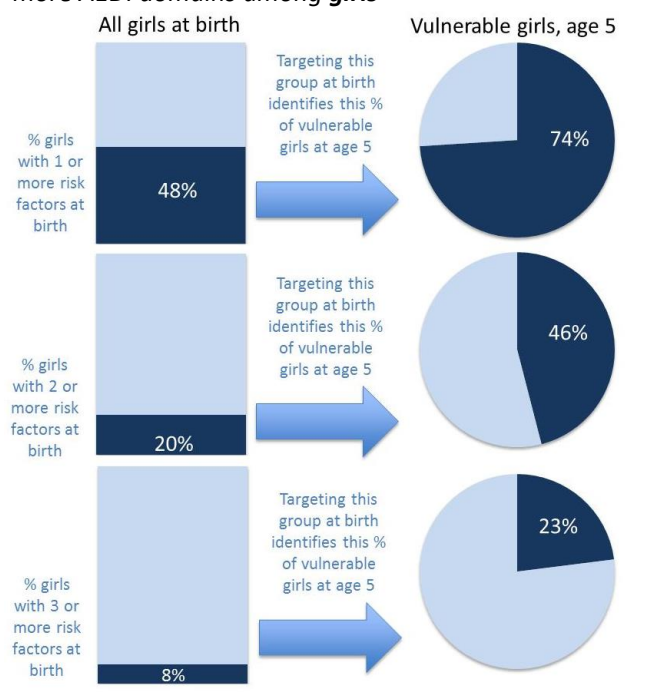
Figure 1 shows the results for boys. At birth, 47% of boys had one or more of the risk factors (the prevalence of the risk factors at birth). If this group was targeted for greater support, it would potentially cover 64% of the boys (the sensitivity of the six risk factors) who were vulnerable on two or more AEDI domains at age 5. If those with 2 or more risk factors (19%) were targeted at birth, then this would identify 35% of the boys who were vulnerable on two or more AEDI domains at age 5.

Figure 2 shows results for girls. At birth, 48% of girls had one or more of the risk factors (the prevalence of the risk factors at birth). If this group was targeted for

greater support, it would potentially cover 74% of the girls (the sensitivity of the six risk factors) who were vulnerable on two or more AEDI domains at age 5. If those with 2 or more risk factors (20%) were targeted at birth, then this would identify 46% of the girls who were vulnerable on two or more AEDI domains at age 5.

Figure 2. *Sensitivity of having at least 1, 2, or 3 of the six risk factors for predicting vulnerability on two or more AEDI domains among* **girls**

more realistic option but the sensitivity of 3 or more risk factors is only 20%, meaning that 80% of the cases of vulnerability at age 5 would be missed.

Following the postnatal period, there are several times when families have contact with service providers, such as well-child checks, immunisations, and entry to preschool. These contact points and the data collected from them are additional opportunities that could be used to improve the prediction models and initiate further interventions for children at risk of poor development. Work continues to refine estimates of predictive validity using other sources of early childhood data as they become available. The estimates presented in this report do not include information on important maternal psychosocial characteristics such as lack of social support and depression. Such measures are being trialled and are likely to be available in the future. Previous research using UK data has shown these to improve predictive validity.[1]

When assessing whether such prediction models could be turned into useful screening tools, policy makers and service providers will need to consider the trade-off between predictive ability measures such as sensitivity, and the proportion of the population that would require services. The evidence from data linkage will assist in better understanding patterns of risk of poor child health and development in SA, and potentially inform how best to identify families whose children may be most at risk of poor development, and who may benefit most from greater support in the first two years of life.

The potential for better targeting of effective programs

Even though the overall predictive validity of these perinatal risk factors at birth is moderate (AUROC ~ 0.70) it is not feasible to use having 1 or more of these risk factors as a cut-off for targeting of services because the service response would need to be provided to almost half of the population aged five. This would mean engaging almost 10,000 five-year-old children in SA. If we considered children with 2 or more of the six risk factors at birth (representing about 20% of the age five population, or about 4,000 five-year old children) we could potentially prevent from about 35-50% (depending on child sex) of the cases of AEDI vulnerability at age 5.

Providing greater support to children and families with 3 or more of the six risk factors (8% of the population at birth, or about 1,600 five-year old children) seems a

References

1. Chittleborough CR, Lawlor DA, Lynch JW. Young maternal age and poor child development: predictive validity from a birth cohort. *Pediatrics* 2011; 127(6):e1436-44